Overcoming the planning fallacy through willpower: Effects of implementation intentions on actual and predicted task completion times.

Koole, S.L.; van 't Spijker, N.

published in
European Journal of Social Psychology
2000

DOI (link to publisher)
10.1002/1099-0992(200011/12)30:6<873::AID-EJSP22>3.3.CO;2-L

document version
Publisher's PDF, also known as Version of record

European Journal of Social Psychology
Eur. J. Soc. Psychol. **30**, 873–888 (2000)

Overcoming the planning fallacy through willpower: effects of implementation intentions on actual and predicted task-completion times

SANDER KOOLE[1]* and MASCHA VAN'T SPIJKER[2]
[1]*Free University Amsterdam, The Netherlands*
[2]*University of Nijmegen, The Netherlands*

Abstract

Previous work has shown that people often underestimate their task-completion times (Buehler, Griffin, & Ross, 1994). The present research examined whether this optimistic bias may be reduced through the formation of implementation intentions. In an experimental study, participants were requested to complete an assignment within a specified time period. Half of these participants made implementation intentions about where and when they would complete the assignment. The remaining participants were simply given the goal of completing the assignment. The results showed that furnishing participants' goals with implementation intentions led to (a) more optimistic completion predictions, (b) an even greater increase in actual rates of goal completion, and, consequently, (c) a significant reduction in optimistic bias in completion predictions. Furthermore, the reduction in optimistic bias among implementation–intention participants was found to be mediated by a smaller number of interruptions while working on the assignment. Together, these findings attest to the importance of implementation planning in overcoming unrealistic optimism in task-completion predictions. Copyright © 2000 John Wiley & Sons, Ltd.

People often believe that they will accomplish their goals more quickly than they actually do (Armor & Taylor, 1998; Buehler, Griffin, & Ross, 1994, 1995). This tendency, also known as the *planning fallacy* (Kahneman & Tversky, 1979), appears to be pervasive at every level of human activity. The history of grand construction projects, for example, is laden with costly failures to meet important deadlines (Hall, 1980). Closer to home, a recent classroom survey showed that students typically finish more than two thirds of their projects later than expected (Buehler *et al.*, 1994).

* Correspondence to: Sander Koole, Department of Social Psychology, Free University Amsterdam, van der Boechorststraat 1, 1081 BT, Amsterdam, NL. e-mail: sl.koole@psy.vu.nl

Received 20 November 1999
Accepted 13 May 2000

Although overly optimistic planning can be beneficial (Armor & Taylor, 1998), it may have detrimental consequences as well. For instance, Baumeister, Heatherton, and Tice (1993) found that inflated performance predictions are associated with making excessive commitments, which may eventually undermine actual performance. In light of these considerations, it seems important to identify circumstances that can promote more realistic planning.

WHY FORECASTERS NEGLECT THEIR PREVIOUS EXPERIENCE: THE CASE FOR SCENARIO THINKING

People make time predictions for a host of everyday tasks (Buehler *et al*., 1995). Moreover, the criteria for evaluating the accuracy of one's time predictions are relatively unambiguous. Thus, people seem to have ample opportunity to learn that their completion predictions suffer from an optimistic bias. Why then, do people continue to make the planning fallacy?

At least part of the answer may lie in the cognitive processes by which people generate their predictions. According to Buehler *et al*. (1994, 1995), people typically arrive at their completion predictions by constructing a mental scenario that sketches out how a given project is likely to develop (cf. Griffin, Dunning, and Ross, 1990; Johnson & Sherman, 1990; Kahneman & Lovallo, 1991). Because people are incapable of taking every possible event into account, these mental scenarios neglect many alternative ways in which the future might unfold. Nevertheless, people will usually rely heavily on their mental scenarios, partly because simply imagining an event increases the perceived likelihood that an event will actually occur (Carroll, 1978; Sherman, Skov, Hervitz, & Stock, 1981; see further Koehler, 1991). Accordingly, the process of scenario thinking may set people up for a rather ironic cycle of events. By holding on to their favorite versions of the future, people may be 'doomed to repeat' the past while knowing it (Buehler *et al*., 1994, p. 366).

The presumed role of scenario thinking was recently subjected to empirical testing by Buehler *et al*. (1994). In this research, think-aloud procedures recorded participants' on-line narratives as they estimated their completion times for various academic tasks. Consistent with the foregoing analysis, participants' narratives were overwhelmingly directed towards their future plans for the current project. At the same time, these narratives were barely concerned with potential impediments or participants' previous experience with similar projects. Thus, these findings confirm the notion that the planning fallacy may arise because people rely on faulty reasoning (i.e. scenario thinking) while they are generating predictions.

WHEN FORECASTERS ENGAGE IN WISHFUL THINKING: THE CASE FOR MOTIVATED REASONING

Research has shown that motivational factors often moderate the types of reasoning that people employ, a phenomenon known as *motivated reasoning* (e.g. De Dreu, Koole, & Oldersma, 1999; for reviews, see Kruglanski & Webster, 1996; Kunda, 1990; Pyszczynski & Greenberg, 1987). It seems plausible that the notion of motivated

reasoning also extends to the task of generating completion predictions. Accordingly, people's wishes and desires may affect their tendency to engage in scenario thinking, thereby producing a change in their level of optimistic bias.

A recent experiment by Buehler, Griffin, and MacDonald (1997) investigated the role of motivated reasoning in making completion predictions. The results showed that participants who had received a speed incentive displayed greater optimistic bias in their completion predictions relative to participants without such an incentive. Supplemental thought-listing protocols revealed that speed incentives caused participants to focus more narrowly on their plans for the upcoming task at the expense of the consideration of past experience. Interestingly, participants who were provided with an accuracy incentive displayed a marginally significant tendency to overestimate their actual completion times, suggesting that these participants tended to err in a pessimistic direction. Taken together, these findings indicate that motivated reasoning can exert a powerful influence on the degree of optimistic bias, in particular by affecting people's propensity to engage in scenario thinking.

Taken at face value, Buehler *et al.*'s (1997) findings would seem to offer a convenient way towards eliminating the planning fallacy. By substituting speed incentives for incentives to make accurate predictions, it may be possible to do away with optimistic bias for good. Unfortunately, this strategy may be accompanied by considerable motivational costs. As it turns out, optimistic expectancies can promote actual task performance, even when those expectancies turn out to be unrealistic (Buehler, MacDonald, & Griffin 1994, cited in Buehler *et al.*, 1995). Tempering people's optimism may therefore frequently be ill-advised, because doing so may undermine people's subsequent motivation and performance. Thus, it would appear that a certain amount of optimistic bias in completion predictions is often inevitable.

FROM GOAL SETTING TO GOAL STRIVING: THE VOLITIONAL BENEFITS OF PLANNING

Or is it? Suppose if people could increase the effectiveness of their goal pursuits to such a degree that even their highly optimistic goals could be met. If that were possible, people could retain their optimistic outlooks without making excessive commitments. Although this may sound too good to be true, there may actually exist a mental strategy that is capable of sufficiently boosting the effectiveness of people's goal pursuits.

To understand how this can occur, we need to consider in more detail how the process of planning mentally prepares the individual for future action (Gollwitzer, 1990, 1993, 1996, 1999; Gollwitzer & Schaal, 1998). Drawing from notions in classic German will psychology (Ach, 1910), Heckhausen (1991) and Gollwitzer (1993) proposed that planning consists of two successive stages, goal setting and goal striving. The specific tasks addressed in each stage are further assumed to activate different cognitive procedures or 'mindsets' (Gollwitzer, Heckhausen, & Steller, 1990; Heckhausen & Gollwitzer, 1987). During the stage of goal setting, the individual presumably acquires a deliberative mindset, i.e. an orientation towards an accurate analysis of feasibility-related information. During the subsequent stage of goal striving, the individual presumably acquires an implemental mindset, i.e. an

orientation towards a self-serving, optimistic analysis of information. Relevant research has produced support for the hypothesized qualitative differences between deliberative and implemental mindsets (Beckmann & Gollwitzer, 1987; Gollwitzer & Kinney, 1989; Gollwitzer *et al.*, 1990; Heckhausen & Gollwitzer, 1987; Taylor & Gollwitzer, 1995). Most relevant here, recent research by Armor and Taylor (discussed in Armor & Taylor, 1998, unpublished manuscript) has shown that optimistic bias in completion predictions becomes increased when people have an implemental mindset, and decreased when they have a deliberative mindset.

Although the above-mentioned research suggests that contemplating the implementation of one's goals mainly serves to increase the planning fallacy, it should be kept in mind that this research mainly addressed the effects of cognitive mindset. Implemental mindsets are ultimately geared towards facilitating action implementation, but they are primarily directed towards people's cognitive functioning (Gollwitzer, 1996). To maximize the action-facilitating effects of planning, additional volitional strategies may be required (Gollwitzer, 1999). Specifically, people may furnish their *goal intentions*, or commitments to particular goals, with *implementation intentions*, concrete action plans that specify when, where, and how, to act. Laboratory experiments have shown that implementation intentions cause the mental representation of the anticipated situation to become highly activated and thus easily accessible (Aarts, Dijksterhuis, & Midden, 1999; Steller, 1992, discussed in Gollwitzer, 1999). Furthermore, the formation of implementation intentions serves to automatize action initiation (Aarts & Dijksterhuis, 2000; Gollwitzer & Brandstätter, 1997; Malzacher, 1992, discussed in Gollwitzer, 1999). Implementation intentions can also be useful after action initiation has taken place, by helping people to ward off distractions stemming from alternative goal pursuits (Patterson & Mischel, 1976; Schaal & Gollwitzer, 1999, discussed in Gollwitzer, 1999).

Research has further shown that implementation intentions can exert strong effects on behavior outside of the laboratory. In one study, Gollwitzer and Brandstätter (1997) found that the formation of implementation intentions helped participants to complete an assignment during their Christmas break within a fixed deadline. Similar findings have been obtained in other research, indicating that implementation intentions are helpful in promoting a variety of health-promotion and disease-prevention behaviors, such as performing breast self-examinations (Orbell, Hodgkins, & Sheeran, 1997), regular intake of a vitamin supplement (Sheeran & Orbell, 1999), and eating healthy foods (Verplanken & Faes, 1999). Taken together, these findings suggest that implementation intentions constitute a powerful self-regulatory tool that serves to bring people's actions in line with their goals (Gollwitzer, 1999). As such, it seems conceivable that the formation of implementation intentions can help to reduce the planning fallacy.

THE PRESENT RESEARCH AND HYPOTHESES

The foregoing discussed two powerful lines of research that are especially relevant to the understanding of optimistic planning. The first has focused on cognitive and motivational determinants of optimism in specific task-completion predictions

(Buehler *et al*., 1994, 1997). The second line of research has predominantly focused on volitional determinants of global optimism and goal-completion rates (Gollwitzer & Brandstätter, 1997; Taylor & Gollwitzer, 1995). Importantly, these two lines of research have recently been synthesized in a set of studies showing how deliberative versus implemental *mindsets* affect task-specific optimism and completion rates (see Armor & Taylor, 1997). In the present research, we sought to expand on this new synthesis by examining the utility of *implementation intentions* in reducing unrealistic optimism in specific task-completion predictions.[1] This extension is theoretically important because the volitional benefits of planning should be at a maximum when the individual has engaged in implementation planning that is directly relevant to the task at hand. Thus, previous research may have underestimated the potential of implementation planning in combatting optimistic bias in task-completion predictions.

To address these issues, we adapted the report assignment paradigm developed by Gollwitzer and Brandstätter (1997). Following this paradigm, we gave our participants the assignment to write a report concerning a particular day in the near future. As in Gollwitzer and Brandstätter (1997), one half of the participants were requested to form implementation intentions regarding where and when to write the report. The remaining participants were simply requested to write the report. Immediately following this manipulation, participants were asked to predict their rates of completing the assignment. Participants then recorded their actual initiation and completion rates for working on the assignment.

In light of previous findings that contemplating the implementation of one's goals fosters an optimistic mindset (Armor & Taylor, 1997; Taylor & Gollwitzer, 1995), we predicted that implementation–intention participants would be more optimistic in their completion predictions than control participants. In addition, we predicted that forming an implementation intention would result in an actual increase of participants' rates of goal completion. Third, and most important, we hypothesized that the effects of implementation intentions would be greater for actual than for predicted behavior. This hypothesis was based on previous findings that behavioral effects of implementation intentions are particularly strong (cf. Gollwitzer, 1999). Accordingly, implementation–intention participants were expected to display less optimistic bias in their forecasting than control participants.

Besides the above-mentioned hypotheses, the present research also addressed some of the behavioral mechanisms that may mediate the influence of implementation planning. First, previous work by Gollwitzer and Brandstätter (1997) indicates that implementation intentions may be especially helpful in the service of initiating goal-directed behavior. To assess whether the formation of implementation intentions had a differential impact on task initiation and task completion, we obtained separate assessments of predicted and actual rates of task initiation and task completion. Second, we explored the potential shielding function of implementation planning. According to Buehler *et al*. (1995), goal interruptions constitute an important source

[1] It is important to note that our predictions were only concerned with directional (optimistic) bias in prediction. Correspondence between predictions and actual completion times can also be assessed at the correlational level. This correlational form of predictive accuracy needs to be distinguished from directional bias both theoretically and empirically (Buehler *et al*., 1994; see also Funder & Colvin, 1997). However, in keeping with previous research on the planning fallacy (Armor & Taylor, 1997; Buehler *et al*., 1994, 1997), we were primarily interested in the determinants of directional bias.

of optimistic bias in completion predictions, because people generally fail to incorporate such distractions into their plan-based scenarios. As Gollwitzer (1999) have shown, forming implementation intentions can be especially helpful in warding off distractions stemming from alternative goal pursuits. Thus, implementation intentions may help to reduce optimistic bias in completion predictions by reducing the number of interruptions during the execution of the goal. To explore this possibility, we assessed the number of interruptions during task completion (i.e. writing the report), and investigated whether reductions in optimistic bias due to forming implementation intentions were mediated by corresponding reductions in the number of interruptions.

METHOD

Participants and Design

One hundred and twenty undergraduate students (28 men and 92 women, average age 22 years) from the University of Nijmegen were randomly assigned to one of two experimental conditions (goal intention or implementation intention). As soon as participants' reports were returned to the laboratory, participants were paid Dfl. 7,50 (approximately US$4) for their participation.

Overall, 80 participants (i.e. 67% of the original sample) returned their report within the assigned period. The return rate was virtually equal between the two experimental conditions (39 versus 41). Empirically, this null finding corroborates Gollwitzer and Brandstätter (1997, Experiment 2), who similarly failed to find an effect on return rates (in fact, return rates in their experiment were slightly higher in the goal-intention condition than in the implementation–intention condition). Although the absence of an effect of implementation planning on return rates may seem at odds with the current hypotheses, this finding actually agrees with the line of thinking that inspired the present research. Theoretically, return rates represent a motivational variable, given that they involve the issue 'Shall I engage in this task or not?'. Thus, given that implementation planning represents a volitional manipulation, its lack of effects on return rates is not surprising. Instead, effects of implementation planning should only emerge on goal-completion rates, which represent a volitional variable because they involve the how and when of goal pursuits. As such, the lack of effects on return rates, in conjunction with the findings for goal-completion rates (see the Results section), support the usefulness of discriminating between motivational and volitional variables.

Procedure

During a two-week period, participants were recruited at the psychology department in Nijmegen. Upon their arrival in the laboratory, participants were seated in individual cubicles, where they received a written instruction. The first part of the instruction was identical for both conditions. It was explained that the study was concerned with how students spend their leisure time. Participants were told that they were to write a lively report of their experiences during a specific day of their lives. This day was to be chosen by participants themselves, but had to fall within an

assigned period of one week. This was always one week after the instruction was given. It was explained that memories of experiences during leisure time fade rather quickly so that it was important to write the report as quickly as possible after the day of the report. Preferably, the report was to be written within one day after the report day had passed. The report itself was to be returned within two weeks after the assigned week had passed. Instructions further stressed that participants would remain anonymous. Anonymity was secured by a specific coding scheme that required participants to create their own code number from three letters and a digit (i.e. first letter of mother's first name, of her maiden name, and of their own place of birth).

After the assignment was explained to them, participants were asked to predict on which day they would start writing the report and on which they thought they would be finished writing it. Participants were told to write their predictions on the instruction sheet. At this point, instructions started to differ between conditions. Following the procedure outlined by Gollwitzer and Brandstätter (1997), participants in the implementation–intention condition were asked to make the same predictions, but were also asked to specify when and where they intended to write their report. They picked a specific point in time (e.g. right after breakfast the next morning) and a certain place (e.g. in a quiet corner in the living room) for starting to write. Moreover, they were asked to visualize the chosen situation and to commit themselves to seize it by silently saying 'I intend to write the report in situation *x*'. In addition, participants were requested to record their choices of time and place on the instruction sheet. Goal-intention participants did not go through this part of the procedure.

After participants handed the instruction sheets to the experimenter, they were supplied with a prepared form on which they were to write the report. Participants were requested to write down their personal code and to record every occasion and the times (date, hour, and minute; from beginning to end) when they had been working on the report. They also received a stamped envelope carrying the address of the social psychology department. In a short oral instruction, the experimenter repeated that participants should write as valid a report as possible using no more than two pages (the form consisted of two pages only). All participants were asked to send the finished reports back as soon as possible.

Finally, participants were asked to put their personal codes and bank account numbers on a separate form. It was explained that we would need this information in order to deposit their participation fees to their bank accounts after we had received their completed assignments. This form was kept separately from the instruction sheets and it was stressed that all the data were confidential and that there was no way to identify the participants. Two weeks after the last assigned period had passed, the promised fees were transferred to the participants who had returned their reports.[2]

[2] Due to an administrative error, the postmarks on participants' return envelopes were not stamped. Consequently, it was not possible to check the dates of returning the assignment on the postmarks. Fortunately, the results by Gollwitzer and Brandstätter (1997) have shown that in the present paradigm, there exists very high convergence between objective completion times and those reported by the participants themselves.

RESULTS

Treatment of the Data

On average, participants reported spending 45 uninterrupted minutes writing the report. These self-reported uninterrupted writing times did not differ between conditions, $F < 1.5$. This nonsignificant result is meaningful, because it reduces the suspicion that participants in the implementation–intention condition were simply less thorough in their fulfillment of the experimental assignment than participants in the goal-intention condition.

Task-initiation times were computed relative to the chosen report days. Thus, an initiation time of 1 indicates that a participant reported that he or she began working on the report one day after the chosen report day had gone by. Similarly, the days on which participants finished the report (to be called: completion times) were corrected for the initiation date by subtracting the initiation dates from the completion dates. Thus, a task-completion time of 1 indicates that a participant reported having finished the report one day after he or she started working on it.

Actual and Predicted Task-completion Times

Predicted and actual rates of goal completion were subjected to a 2 (condition: implementation intention or goal intention) $\times$ 2 (action phase: initiation or completion) $\times$ 2 (type of measure: prediction or behavior) mixed-model ANOVA, with repeated measures on the second and third factors. This analysis revealed a significant effect of action phase, $F(1,78) = 4.06$, $p < 0.05$, which indicated that predicted and actual initiation times were longer than predicted and actual completion times ($M = 1.03$ versus $M = 0.57$). Because the action phase factor did not interact with the other factors, it was dropped from the analyses reported here. We refer to initiation and completion times together as 'rates of goal completion'. Relevant means are displayed in Table 1.

The analysis further showed a main effect of type of measure, $F(1,78) = 8.17$, $p < 0.006$, indicating that, on average, predicted rates of goal completion were faster than actual rates of goal completion ($M = 1.25$ versus $M = 1.94$). In addition, a main effect was found for condition, $F(1,78) = 11.14$, $p < 0.002$. Separate analyses revealed that participants in the implementation intention predicted faster rates of goal completion than participants in the goal-intention condition, $F(1,78) = 5.32$, $p < 0.03$ ($M = 0.85$ versus $M = 1.67$). In addition, actual rates of goal completion were significantly faster in the implementation intention than in the goal-intention condition, $F(1,78) = 10.97$, $p < 0.002$ ($M = 1.02$ versus $M = 2.90$).

Importantly, the expected interaction between condition and type of measure was obtained, $F(1,78) = 4.67$, $p < 0.04$. Further analyses showed that unrealistic

Table 1. Predicted and actual rates of goal completion (in days) as a function of condition

Condition	Predicted	Actual	Unrealistic optimism
Implementation intention	0.85	1.02	0.17
Goal intention	1.67	2.90	1.23

optimism, indexed by the difference between predicted and actual rates of goal completion, was smaller in the implementation–intention condition than in the goal-intention condition, ($M = 0.17$ versus $M = 1.23$). In the implementation–intention condition, unrealistic optimism was not reliably different from zero, $F(1,40) = 2.68$, $p = 0.109$. In the goal-intention condition, participants were clearly unrealistically optimistic about their rates of goal completion, $F(1,38) = 6.29$, $p < 0.02$. In short, the formation of implementation intentions led to an important reduction in unrealistic optimism regarding the rates of goal completion.

Absolute Accuracy

Although our main interest was in investigating directional optimistic bias, correspondence between predicted and actual completion times can also be assessed at the correlational level. This correlational index is sometimes referred to as the 'absolute accuracy' of predictions (Buehler *et al.*, 1994). Overall absolute accuracy was high and statistically reliable, $r = 0.55$, $p < 0.001$. This correlation is comparable to that found in similar research (e.g. Buehler *et al.*, 1994). Furthermore, this correlation was not found to vary between the experimental conditions. This finding is consistent with other research showing that directional bias and absolute accuracy are both empirically and theoretically distinct (Buehler *et al.*, 1994, 1995; see also Funder & Colvin, 1997). One explanation for the lack of effects on absolute accuracy may be that implementation planning exerts to a large degree parallel effects on predictions and behavior, so that it may leave the relation between predictions and behavior essentially intact. Another explanation may be that, even in the control condition, the correlation between predictions and behavior was fairly high. Indeed, a recent review (Armor & Taylor, 1998) showed that, despite the existence of a pervasive optimistic bias, people's specific predictions are not indiscriminantly optimistic: they tend to obey the constraints of reality. Given people's apparent sensitivity to the demands of the situation at the correlational level, it may have been difficult for implementation intentions to produce gains in absolute accuracy.

Number of Interruptions

Recall that we had previously hypothesized that implementation intentions might cause a reduction in unrealistic optimism because they can shield ongoing goal pursuits against interruptions. To examine this possibility, we analyzed the number of interruptions during the writing of the assignment. Using participants' self-reports, we used the number of entries participants had listed to count the number of times they were interrupted while working on the assignment. Number of interruptions was then submitted to a oneway between-subjects ANOVA (condition: implementation intention or goal intention). As expected, participants in the implementation–intention conditions reported fewer interruptions than participants in the goal-intention condition, $F(1,78) = 4.09$, $p < 0.05$ ($M = 0.29$ versus $M = 0.62$).

Mediation Analysis

To qualify as a potential mediator, the number of interruptions must not only bear a significant relationship to unrealistic optimism. It must also eliminate or greatly diminish the effect of making implementation intentions on unrealistic optimism, when both number of interruptions and condition are entered into the analysis (Baron & Kenny, 1986). To test for mediation, we conducted a series of separate path analyses (see Figure 1). First, the direct relationship between implementation planning and unrealistic optimism was significant, $\beta = -0.24$, $t(1,78) = -2.13$, $p < 0.04$. Second, implementation planning was predictive of the number of interruptions, $\beta = -0.22$, $t(1,78) = -2.02$, $p < 0.05$. Third, when implementation planning and number of interruptions were entered into the equation simultaneously, the number of interruptions was predictive of unrealistic optimism, $\beta = 0.41$, $t(1,78) = 3.98$, $p < 0.001$. Moreover, the direct relationship between implementation planning and unrealistic optimism became smaller and no longer significant, $\beta = -0.15$, $t(1,78) = -1.41$, $p = 0.163$.

Although the number of interruptions was found to mediate the effect of implementation intentions on the overall rate of goal completion, this mediation effect should logically be restricted to completion times. This is because interruptions while working on the assignment occurred by definition only after participants had initiated the experimental task. Consistent with this, the number of interruptions was significantly correlated with optimistic bias in completion predictions, $r(80) = -0.54$, $p < 0.001$, but not with optimistic bias in initiation predictions, $r(80) = -0.12$, $p = 0.31$. Thus, in line with expectations, the obtained decrease in the number of interruptions only mediated a reduction in optimistic bias in completion predictions, not in initiation predictions.

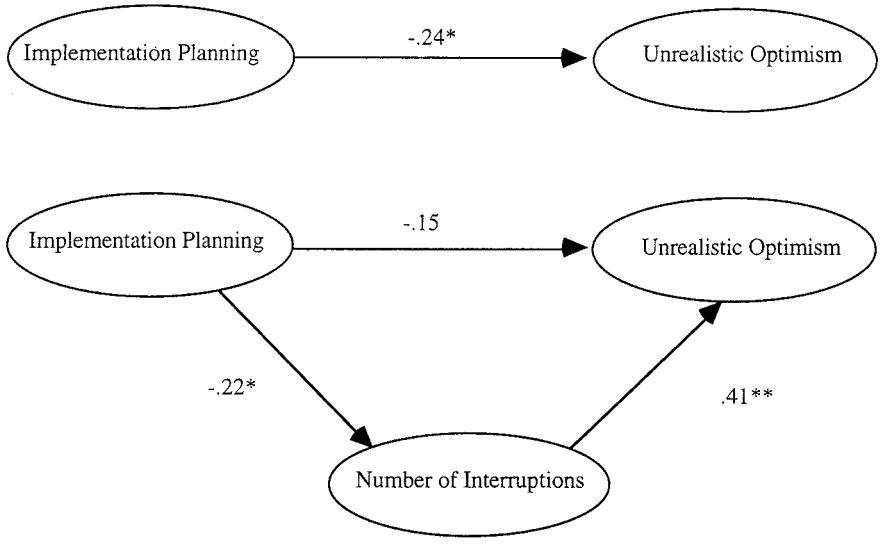

Figure 1. Path analyses depicting the mediating role of number of interruptions on unrealistic optimism as a function of implementation planning. *Notes*: $N = 80$. Coefficients are standardized betas. $^{*}p < 0.05$, $^{**}p < 0.001$

DISCUSSION

People display a ubiquitous tendency to underestimate their task-completion times (Buehler *et al*., 1994, 1995). Previously, researchers have sought to reduce this so-called planning fallacy by leading people to temper their lofty expectations (e.g. Buehler *et al*., 1994, 1997). Implicit in this approach is the notion that it is generally easier to moderate one's optimism than it is to dramatically improve the efficiency of one's goal pursuits. As the current findings show, the effects of forming implementation intentions defy this logic. On the one hand, the formation of implementation intentions led to increased optimism in completion predictions. This confirms earlier findings that reflecting on the implementation of one's actions makes people more optimistic (Armor & Taylor, 1997; Taylor & Gollwitzer, 1995). On the other hand, however, this increase in optimism was exceeded by an increase in actual rates of goal completion due to forming implementation intentions. The net result of forming implementation intentions was therefore a reduction in unfounded optimism. Thus, the present research provides the first unequivocal demonstration that the formation of implementation plans can be an effective aide in attacking optimistic bias in task-completion predictions.

Given that implementation intentions were found to have a powerful influence on thought and action, it is important to identify the processes through which implementation intentions may become effective. At first glance, the formation of implementation intentions may seem very similar to Buehler *et al*.'s (1994, 1995) description of scenario thinking. Indeed, while forming implementation intentions, people are focusing on the future and imagine where and when they intend to work on a given project (e.g. Gollwitzer & Brandstätter, 1997). However, the formation of implementation intentions also includes aspects that are probably absent in spontaneously occurring scenario thinking. In particular, the formation of implementation intentions explicitly requires that people visualize the situation in which a particular behavior will be enacted. Thus, vivid imagination of an intended action may constitute an important ingredient of implementation planning (see also Taylor & Pham, 1996). Moreover, the formation of implementation intentions explicitly recruits people's will power, by asking them to commit themselves to the intended behavior. Prior research has shown that such willful commitment greatly enhances the effectiveness of implementation intentions (Seehausen, Bayer, & Gollwitzer, 1994; Steller, 1992; both discussed in Gollwitzer, 1996).

The present findings also offer further insight into the behavioral mechanisms that may mediate the effectiveness of implementation planning. Following Gollwitzer and Brandstätter (1997), we suspected that implementation intentions might be particularly helpful to get started. Contrary to this, however, implementation intentions were found to be equally effective in both the stage of action initiation and the stage of action completion. It thus appears that our findings cannot be fully explained by the initiation-facilitating effects of implementation intentions. How else could implementation intentions have improved the efficiency of action completion? One informative result is that implementation intentions led to a smaller number of interruptions during action execution. Further analyses showed that the number of interruptions statistically mediated the effects of implementation intentions on

optimistic bias, suggesting that variations in the number of interruptions were able to explain why implementation intentions led to a reduction in optimistic bias.

These interruption findings illuminate several important aspects of optimistic bias in completion predictions. We obtained a strong relation between the number of interruptions and optimistic bias, suggesting that optimistic bias arises when people fail to take interruptions of their goal pursuits into account. This is consistent with Buehler *et al.*'s (1995) theorizing that scenario thinking often leads people to neglect potential impediments during task completion. It further appears that implementation planning promotes more effective shielding against such unexpected interruptions, thus removing this source of bias from people's predictions. Possibly, the shielding function of implementation intentions is established during the stage of action preparation, when people mentally seek out environments where task completion will not be disturbed.[3] Alternatively, the shielding function may be reflective of a cognitive inhibition of distracting stimuli (Gollwitzer, 1991; Schaal & Gollwitzer, 1999, both discussed in Gollwitzer, 1999). Further research is needed to determine which of these possible mechanisms is responsible for reducing the number of interruptions during goal pursuit.

In a way, the present findings indicate that implementation planning may allow people to have their cake and eat it too: they can retain their optimistic outlooks without running the risk of making excessive commitments. Nevertheless, we do not mean to suggest that there are no limits to the benefits of implementation planning. First and foremost, implementation planning only helps when people have chosen reasonable goals (Gollwitzer & Schaal, 1998). Thus, even the most effective implementation planning will be of little help to individuals suffering from delusions of grandeur. The latter group of individuals is probably better off by adjusting their aspirations to more realistic levels. As such, the effectiveness of implementation planning may be dependent on the development of sufficient meta-cognitive abilities to recognize one's own (in)competence (cf. Kruger & Dunning, 1999). Second, forming implementation intentions is only likely to be effective when people have sufficient commitment to their goals (Orbell *et al.*, 1997; cf. Gollwitzer, 1999). Third, forming implementation intentions to execute a specific behavior may reduce a person's flexibility to engage suitable alternatives (Gollwitzer, 1999). This may be harmful under rapidly changing conditions, when there is insufficient time to shift one's commitments. Finally, people's energy resources to engage in willful planning may be limited (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven, Tice, & Baumeister, 1998). A more precise specification of the parameters that limit the effectiveness of implementation planning provides an important agenda for future research.

Before closing, it is important to note some potential limitations of the present research. First, the present research relied on self-reporting to assess actual behavior.

[3] As noted by an anonymous reviewer, the present research allows no means of ascertaining that implementation intention participants actually lived up to their prespecified plans, or whether they were more effective in seeking out distraction-free environments during the action stage. Nevertheless, both theoretical and empirical work by Gollwitzer and associates suggests that implementation intentions are effective by strengthening the cognitive link between intended actions and a prespecified opportunity (e.g. Gollwitzer & Brandstätter, 1997; see also Aarts *et al.*, 1999; Orbell *et al.*, 1997). Thus, it seems theoretically most plausible that any advantage due to a selection of distraction-free environments was already specified during the preactional, planning stage. Further untangling these possibilities may be an interesting avenue for future research.

Thus, a critic might argue that the obtained effects of implementation intentions could be due to social desirability. For several reasons, we believe that this is unlikely. First, we took several precautions to minimize social desirability pressures, making it clear to participants that their responses would remain anonymous. Moreover, the main purpose of the investigation, i.e. examination of optimistic bias, was not revealed to our participants through the use of a cover story. Both of these precautions can be expected to reduce the likelihood that concerns with self-presentation motivated our participants to confirm the experimenter's hypotheses. Finally, the present findings closely parallel other findings in the literature, most notably those obtained by Gollwitzer and Brandstätter (1997). In a highly similar paradigm, Gollwitzer and Brandstätter (1997) found no differences between completion dates reported by their participants and objective-completion dates. Likewise, other research using objective behavioral measures has found that self-reports of behavior are equally trustworthy for participants who have formed implementation intentions and those who have not (e.g. Sheeran & Orbell, 1999). Overall, it appears that the obtained effects of implementation intentions cannot be explained by tendencies to engage in socially desirable reporting.

A second potential limitation is that the present research only examined one indicator of successful goal pursuit, i.e. rates of completing a written assignment. In a recent review, Armor and Taylor (1998) persuasively argued that optimistic expectancies are often highly *situated*: optimistic expectancies tend to be expressed more or less depending on the demands of the situation and the immediate needs of the individual. Thus, the factors that influence optimistic bias in completion predictions are not necessarily the same as the factors that influence optimistic bias in predictions for other task outcomes. Given that other research has found implementation intentions to be effective across a wide variety of behavioral domains (cf. Gollwitzer, 1999), there are grounds for believing that the current findings are generalizable to other settings. Nevertheless, it would be desirable to replicate the current findings using alternative measures of successful goal completion.

CODA

Throughout history, scholars have been skeptical about the causal status of the will. Even long before the days of Ach (1910), Hume (1739/1888; see Wegner & Wheatly, 1999) argued that the will is 'nothing but the internal impression we feel and are conscious of, when we knowingly give rise to any new motion of our body, or new perception of our mind' (p. 399). Although the role of the will in action control continues to be controversial in the present day and age (Baumeister *et al.*, 1998; Wegner & Wheatley, 1999), recent years have witnessed an accumulation of cognitive (Gollwitzer *et al.*, 1990; Goschke & Kuhl, 1993), motivational (Brunstein & Gollwitzer, 1996), and neurological (Kuhl, 1994; Metcalfe & Mischel, 1999) findings linking willful experience to action. The present work adds to this growing body of research that certain forms of willing, i.e. implementation planning, may be especially helpful in overcoming excessive optimism. Willful processes may thus serve a crucial function in connecting thought to action. As such, it seems worth while to keep the will alive in psychological theorizing.

REFERENCES

Aarts H, Dijksterhuis A. 2000. Habits as knowledge structures: Automaticity in goal-directed behaviors. *Journal of Personality and Social Psychology* **78**: 53–63.

Aarts H, Dijksterhuis A, Midden C. 1999. To plan or not to plan? Goal achievement or interrupting the performance of mundane behaviors. *European Journal of Social Psychology* **29**: 971–979.

Ach N. 1910. *Über den Willensakt und das Temperament*. Quelle & Meyer: Leipzig.

Armor DA, Taylor SE. 1998. Situated optimism: Specific outcome expectancies and self-regulation. In *Advances in Experimental Social Psychology* (Vol. 30), Zanna MP (ed.). Academic Press: New York; 309–379.

Baron RM, Kenny DA. 1986. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology* **51**: 1173–1182.

Baumeister RF, Bratslavsky E, Muraven M, Tice D. 1998. Ego depletion: Is the self a limited resource? *Journal of Personality and Social Psychology* **74**: 1252–1265.

Baumeister RF, Heatherton TF, Tice DM. 1993. When ego threats lead to self-regulation failure: Negative consequences of high self-esteem. *Journal of Personality and Social Psychology* **64**: 141–156.

Beckmann J, Gollwitzer PM. 1987. Deliberative versus implemental states of mind: The issue of impartiality in predecisional and postdecisional processing. *Social Cognition* **5**: 259–279.

Brunstein JC, Gollwitzer PM. 1996. Effects of failure on subsequent performance: The importance of self-defining goals. *Journal of Personality and Social Psychology* **70**: 395–407.

Buehler R, Griffin D, MacDonald H. 1997. The role of motivated reasoning in optimistic time predictions. *Personality and Social Psychology Bulletin* **23**: 238–247.

Buehler R, Griffin D, Ross M. 1994. Exploring the 'planning fallacy': Why people underestimate their task completion times. *Journal of Personality and Social Psychology* **67**: 366–381.

Buehler R, Griffin D, Ross M. 1995. It's about time: Optimistic predictions in work and love. *European Review of Social Psychology* **6**: 1–32.

Carroll JS. 1978. The effect of imagining an event on expectations for the event: An interpretation in terms of the availability heuristic. *Journal of Experimental Social Psychology* **14**: 88–96.

De Dreu CKW, Koole SL, Oldersma FL. 1999. On the seizing and freezing of negotiator inferences: Need for closure moderates the use of heuristics in negotiation. *Personality and Social Psychology Bulletin* **25**: 348–362.

Funder DC, Colvin CR. 1997. Congruence of others' and self-judgments of personality. In *Handbook of Personality Psychology*, Hogan R, Johnson J, Briggs S (eds). Academic Press: London; 617–647.

Gollwitzer PM. 1990. Action phases and mindsets. In *Handbook of Motivation and Cognition* (Vol. 2), Higgins ET, Sorrentino RM (eds). Guilford: New York; 51–92.

Gollwitzer PM. 1993. Goal achievement: The role of intentions. *European Review of Social Psychology* **4**: 141–142.

Gollwitzer PM. 1996. The volitional benefits of planning. In *The Psychology of Action*, Gollwitzer PM, Bargh JA (eds). Guilford: New York; 287–312.

Gollwitzer PM. 1999. Implementation intentions: Strong effects of simple plans. *American Psychologist* **54**: 493–503.

Gollwitzer PM, Brandstätter V. 1997. Implementation intentions and effective goal pursuit. *Journal of Personality and Social Psychology* **73**: 186–199.

Gollwitzer PM, Heckhausen H, Steller B. 1990. Deliberative and implemental mind-sets: Cognitive tuning toward congruous thoughts and information. *Journal of Personality and Social Psychology* **59**: 1119–1127.

Gollwitzer PM, Kinney RF. 1989. Effects of deliberative and implemental mindsets on illusion of control. *Journal of Personality and Social Psychology* **56**: 531–542.

Gollwitzer PM, Kirchhof O. 1998. The willful pursuit of identity. In *Motivation and Self-regulation across the Life-span*, Heckausen M, Peck CS (eds). Cambridge University Press: New York, 389–423.

Gollwitzer PM, Schaal B. 1998. Meta-cognition in action: The importance of implementation intentions. *Personality and Social Psychology Bulletin* **2**: 124–136.

Goschke T, Kuhl J. 1993. Representation of intentions: Persisting activation in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition* **19**: 1211–1226.

Griffin DW, Dunning D, Ross L. 1990. The role of construal processes in overconfident predictions about the self and others. *Journal of Personality and Social Psychology* **59**: 1128–1139.

Hall P. 1980. *Great Planning Disasters*. Weidenfeld and Nicolson: London.

Heckhausen H. 1991. *Motivation and Action*. Springer: London.

Heckhausen H, Gollwitzer PM. 1987. Thought contents and cognitive functioning in motivational versus volitional states of mind. *Motivation and Emotion* **11**: 101–120.

Hume D. 1888. In *A treatise on human nature*, Selfby-Bigge LA (ed.). Oxford University Press: London (Original work published 1739).

Johnson MK, Sherman SJ. 1990. Constructing and reconstructing the past and the future in the present. In *Handbook of Motivation and Cognition* (Vol. 2), Higgins ET, Sorrentino RM (eds). Guilford Press: New York; 482–526.

Kahneman D, Lovallo D. 1991. Bold forecasting and timid decisions: A cognitive perspective on risk taking. In *Fundamental Issues in Strategy*, Rumelt R, Schendel P, Teece D (eds). Cambridge University Press: Cambridge.

Kahneman D, Tversky A. 1979. Intuitive prediction: Biases and corrective procedures. *TIMS Studies in Management Science* **12**: 313–327.

Koehler DJ. 1991. Explanation, imagination, and confidence in judgment. *Psychological Bulletin* **110**: 499–519.

Kruger J, Dunning D. 1999. Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology* **77**: 1121–1134.

Kruglanski AW, Webster DM. 1996. Motivated closing of the mind: 'Seizing' and 'freezing'. *Psychological Review* **103**: 263–283.

Kuhl J. 1994. A theory of action and state orientations. In *Volition and Personality*, Kuhl J, Beckmann J (eds). Hogrefe & Huber: Göttingen; 9–46.

Kunda Z. 1990. The case for motivated reasoning. *Psychological Bulletin* **108**: 480–498.

Metcalfe J, Mischel W. 1999. A hot/cool analysis of delay of gratification: Dynamics of willpower. *Psychological Review* **106**: 3–19.

Muraven M, Tice DM, Baumeister RF. 1998. Self-control as limited resource: Regulatory depletion patterns. *Journal of Personality and Social Psychology* **74**: 774–789.

Murgraff V, White D, Philips K. 1996. Moderating binge drinking: It is possible to change behaviour if you plan it in advance. *Alcohol & Alcoholism* **31**: 577–582.

Orbell S, Hodgkins S, Sheeran P. 1997. Implementation intentions and the theory of planned behavior. *Personality and Social Psychology Bulletin* **23**: 945–954.

Patterson CJ, Mischel W. 1976. Effects of temptation-inhibiting and task-facilitating plans on self-control. *Journal of Personality and Social Psychology* **33**: 209–217.

Pyszczynski T, Greenberg J. 1987. Toward an integration of cognitive and motivational perspectives on social inference: A biased hypothesis-testing model. In *Advances in Experimental Social Psychology* (Vol. 20), Berkowitz L (ed.). Academic Press: New York; 297–340.

Sheeran P, Orbell S. 1999. Implementation intentions and repeated behavior: Augmenting the predictive validity of the theory of planned behaviour. *European Journal of Social Psychology* **29**: 349–369.

Sherman SJ, Shov RB, Hervitz EF, Stock CB. 1981. The effects of explaining hypothetical future events: From possibility to probability to actuality and beyond. *Journal of Experimental Social Psychology* **17**: 142–158.

Sherman SJ. 1980. On the self-erasing nature of errors of prediction. *Journal of Personality and Social Psychology* **39**: 211–221.

Taylor SE, Gollwitzer PM. 1995. Effects of mindset on positive illusions. *Journal of Personality and Social Psychology* **69**: 213–226.

Taylor SE, Pham LB. 1996. Mental simulation, motivation, and action. In *The Psychology of Action*, Bargh JA, Gollwitzer PM (eds). Guilford: New York; 219–235.

Verplanken B, Faes S. 1999. Good intentions, bad habits, and effects of forming implementation intentions on healthy eating. *European Journal of Social Psychology* **29**: 591–604.

Wegner DM, Wheatley T. 1999. Apparent mental causation: Sources of the experience of will. *American Psychologist* **54**: 480–492.

